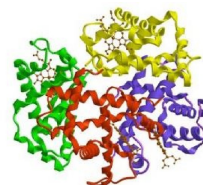
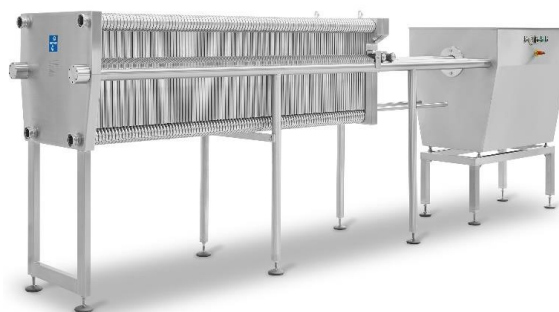
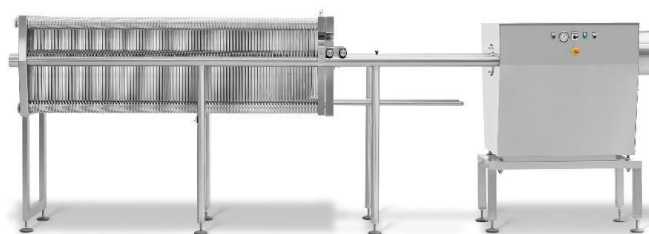


Enzymes

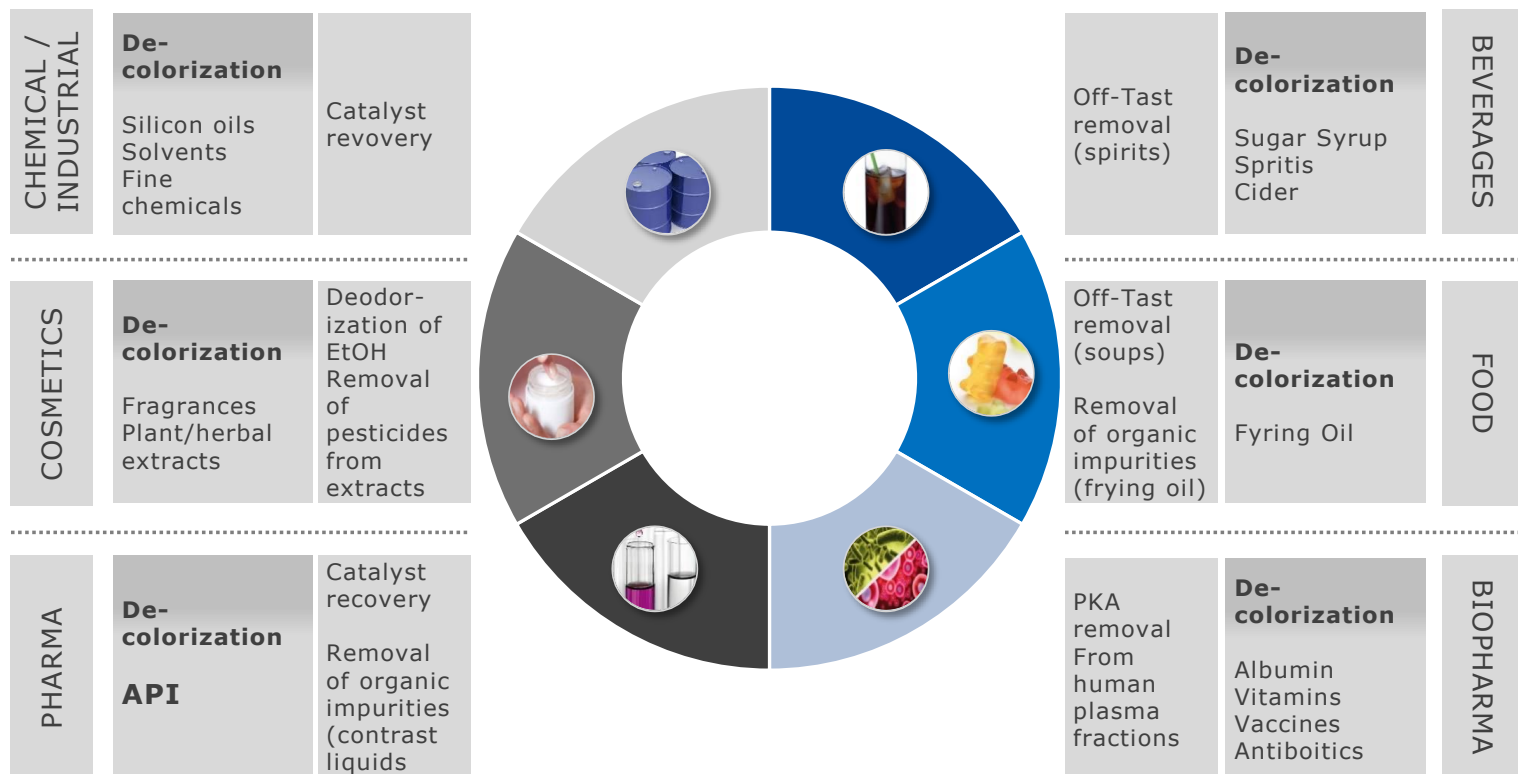
POTENTIAL CUSTOMERS



Example Novozymes

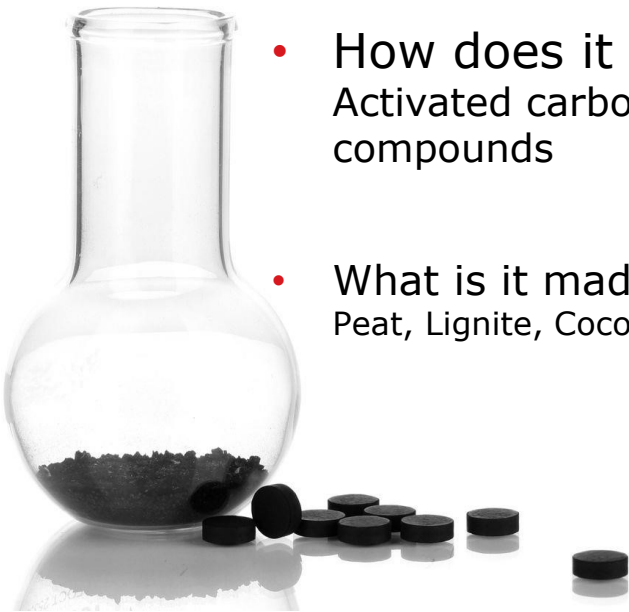


APPLICATION OVERVIEW AC



ACTIVATED CARBON

- **What is activated carbon?**
Activated Carbon is a crude form of graphite and generic term used to describe a family of carbonaceous adsorbents possessing a highly crystalline form and extensively developed internal pore structure.
- **How does it act?**
Activated carbon adsorbs organic impurities and carbon compounds
- **What is it made out of?**
Peat, Lignite, Coconut shells, Coal, Olive kernels, apricot kernels,...

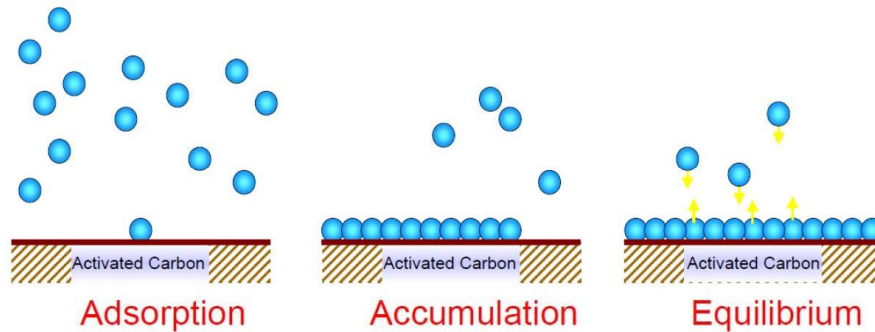


ADSORPTION VS. ABSORPTION



ADSORPTION

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to a surface



High inner surface requested
(1 tea spoon of activated carbon has a surface area of a soccer field):

Adsorbens	Surface [m ² g ⁻¹]
Glass pellets	Approx. 5
Silica Gel	300 - 350
Activated Carbon	300 - 2'500

ACTIVATION

Process Target:

Production of a porous system with a larger inner surface. Poresize distribution and active inner surfaces will vary depending on target application!

Common Processes:

- **Steam and / or CO₂:**
Temperature: 700-1'000°C
from low to high activation degree
($> 1200 \text{ m}^2\text{g}^{-1}$)
carbonisation prior to activation
Generates pore radius of 1-25nm
- **Chemical Activation (ZnCl₂ or H₃PO₄)**
Temperature: 400-700°C
medium activation degree
the chemicals bind the water
in the plant based raw material
Generates pore radius of $>25\text{nm}$



PORE SIZES

- Source and activation method have an influence on the inner surface (pore size distribution)
- Pore Size Definition by IUPAC (International Union of Pure and Applied Chemistry)



Iodine index

● = Iodine

Micropore ($r < 1 \text{ nm}$)



Methylene blue

● = Methylene blue

Mesopore ($1 < r < 25 \text{ nm}$)



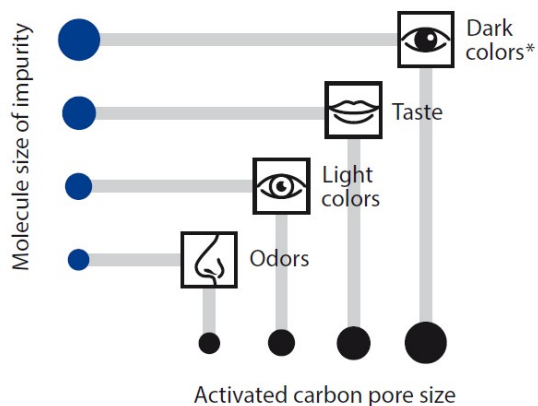
Molasses index

● = Molasses

Macropore ($r > 25 \text{ nm}$)

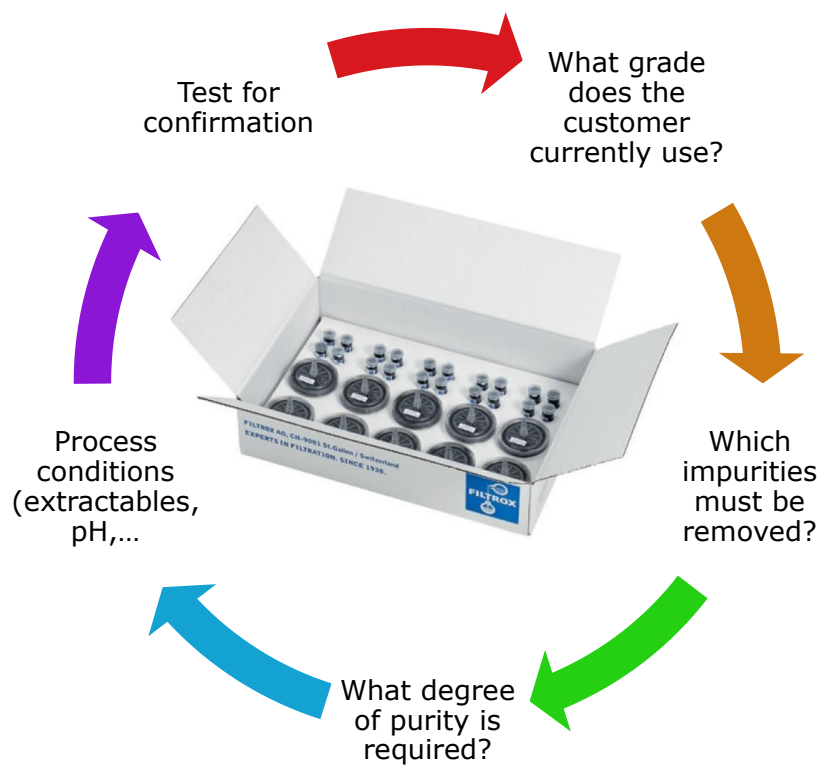
ROLE OF PORE SIZE DISTRIBUTION

Activation Type	Target Molecules	Examples
Chemical	High molecular weight	Dark colorants, proteins,...
Steam	Low molecular weight	Light colorants, color precursors, solvents, off-taste, smell



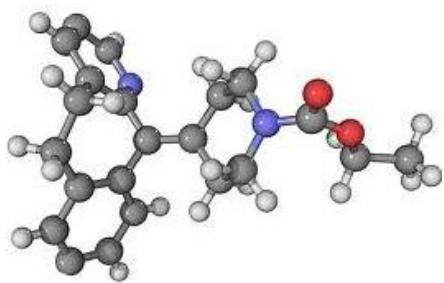
GRADE EVALUATION

How to choose the best working carbon grade:



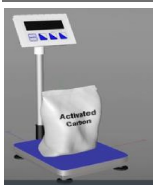
API PROCESS

- In 90% of the API processes, activated carbon is added
- Carbon handling is one of the key issues in API manufacturing



WHY IMMOBILIZED CARBON?

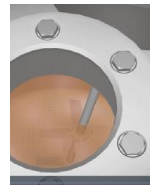
Handling of PAC



PAC Bags
Weight
control



Carbon feeder
→ open system
during loading



Carbon needs
residence time in the
reactor

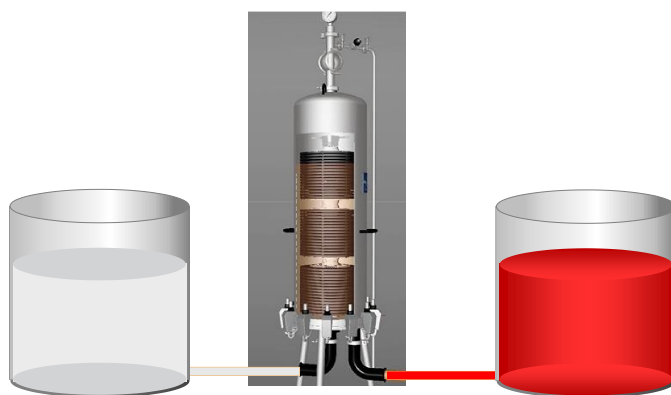


Nutsch filter to tak
out carbon particles



Filter media with immobilized
AC are much simpler to handle

Handling of Immobilized Carbon





WHY IMMOBILIZED CARBON?

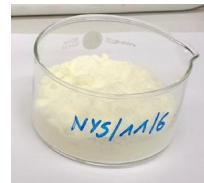
- Efficiency
 - Higher concentration in filter sheet results in higher efficiency
- Costs
 - Only one process step
 - Less labor intensive and faster
 - No cleaning
- Safety
 - No health and safety issues for operators
 - GMP suitability → process safety

Case study 1

- Removal of Polymorphs
 - Powdered API produced by crystallization
 - Goal: removal of various pigments and other particles by surface filtration
 - Result 1:



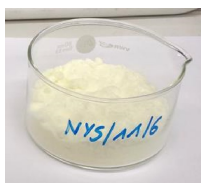
Unfiltered



Filtered with depth filtration
and filter aid

Case study 1

- Removal of Polymorphs
 - Second process step needed to remove color
 - Goal: remove color
 - Result 2:



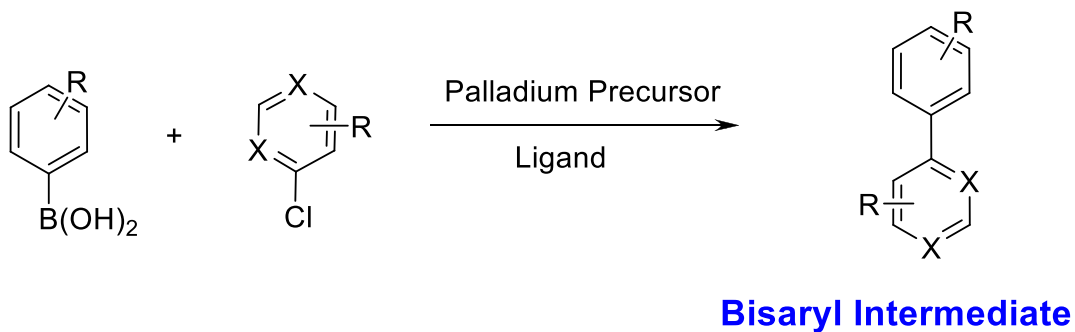
Filtered with depth filtration
and filter aid



CARBOFIL CA
treated

Case study 2

- Removal of Heavy Metals (Palladium)
 - Palladium is used as precursor in the Suzuki-Miyaura coupling for API synthesis
 - Bisaryl Intermediate contains more than 500 ppm Palladium, allowed are 60 ppm



- Goal: removal of Palladium with an efficient and consistent process



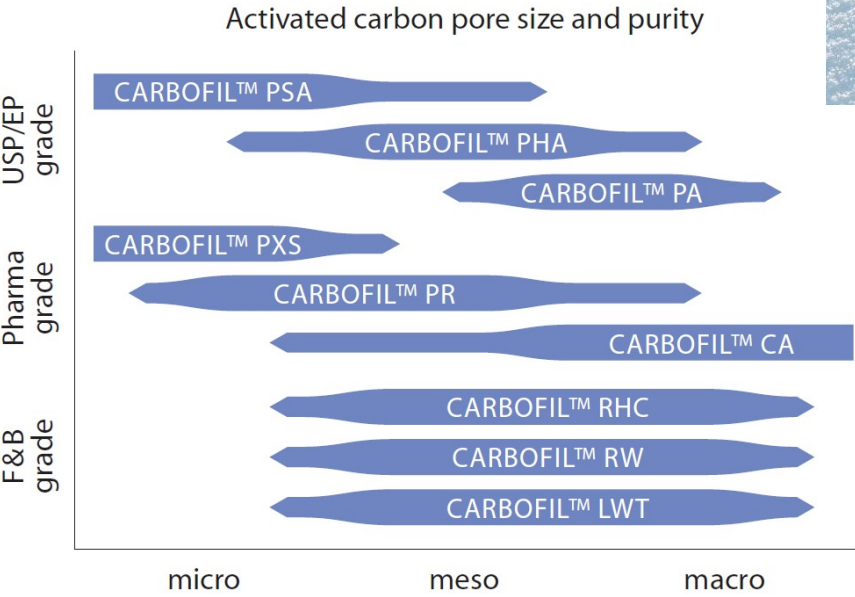
Case study 2

- Removal of Heavy Metals (Palladium)
- Possible processes:

Technique for precious metal removal	Pd level in Intermediate	Additional costs
Crystallization	> 500 ppm	-
Palladium Scavanger	Not tested	> 15,- € / kg
Extraction with Cystein	80 – 120 ppm	3 € / kg
Extraction with Sodium Bisulfite	5 – 76 ppm	< 1 € / kg
Extraction with Sodium Bisulfite and CARBOFIL CA treatment	Average 12 ppm	~ 1.50 € / kg



PRODUCT PORTFOLIO



CARBOFIL™ PLUS

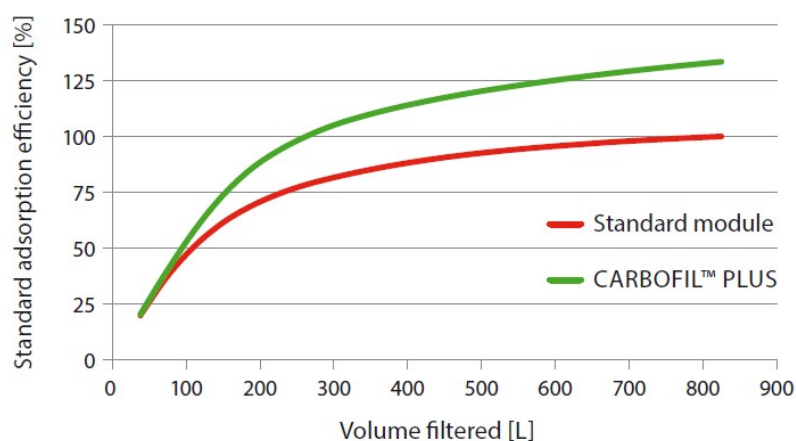


Chart: Comparison of adsorption capacity between a standard carbon module and the CARBOFIL™ PLUS.

	CARBOFIL™ PLUS DOR	CARBOFIL™ PLUS DOE	CARBOFIL™ standard DOR	CARBOFIL™ standard DOE
Diameter [mm]	400	400	400	400
Height [mm]	330	275	330	275
Number of cells	9	10	15	16
Carbon content/ module [g]	3150	3500	2625	2800

MANUFACTURING EXCELLENCE

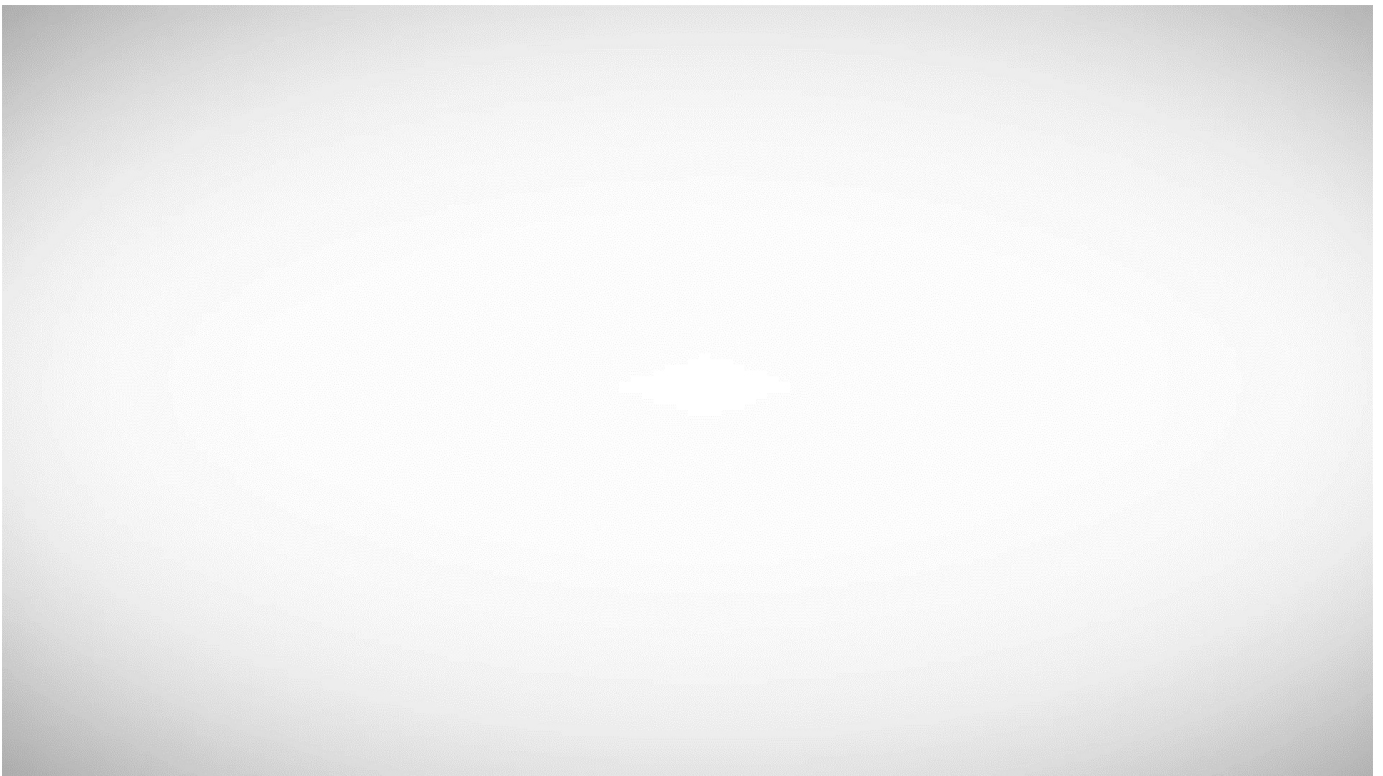


- The FILTROX Group manufactures carbon media on several different lines → high flexibility
- Large experience in manufacturing carbon media
- We can offer custom made immobilized carbon modules!
- Small batches can be produced on a pilot line (min. order quantity approx. 150m²)

FILTROX in Life Sciences

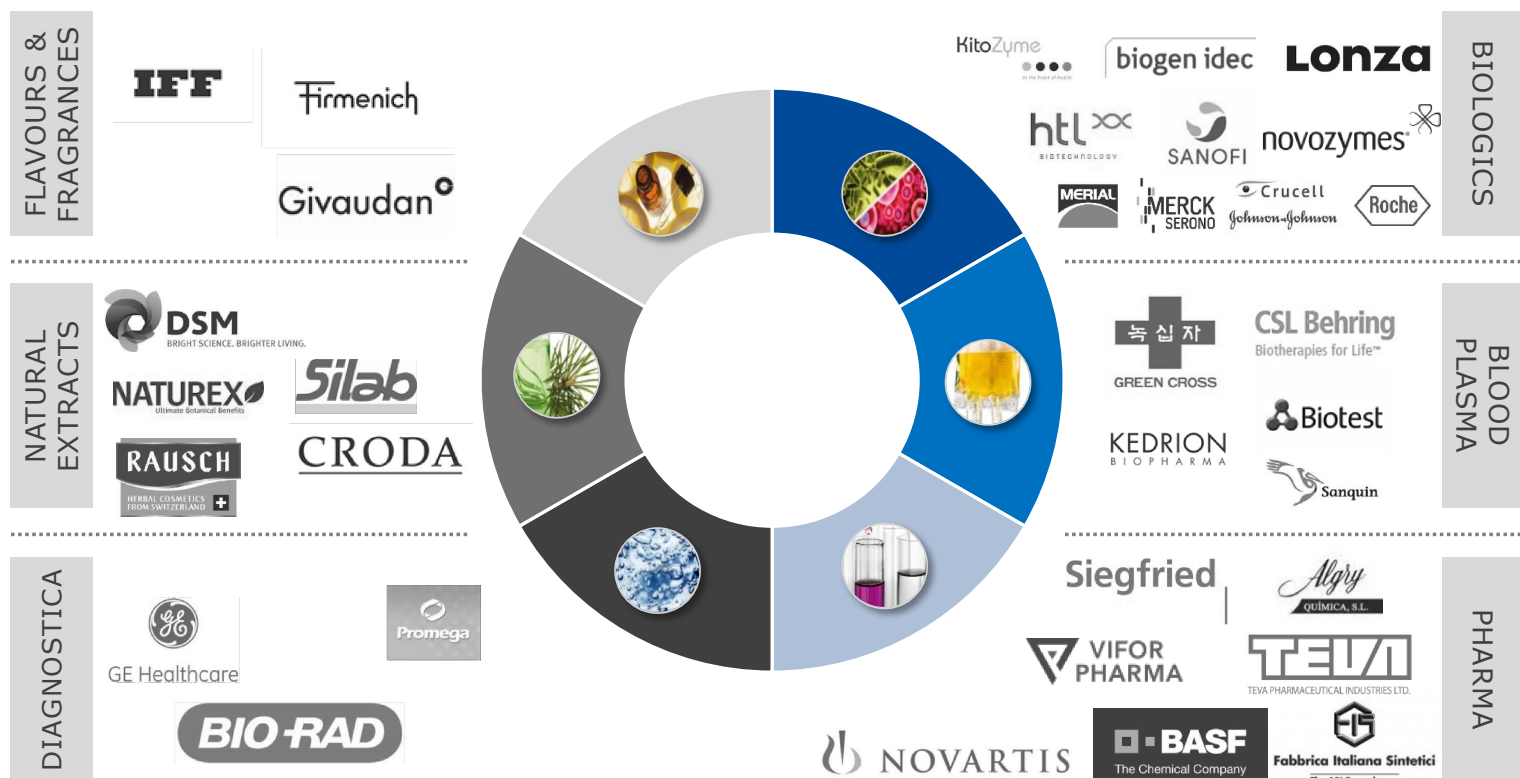


Activated Carbon



REFERENCE CUSTOMERS

SELECTION LIFE SCIENCES





OPPORTUNITIES

- We can offer process optimization by providing better and more cost effective solutions
- There are opportunities in each market
- We are more flexible than the competition
- We know much better how depth filtration works
- We are a team that can help you to realize projects

- Go for it!



SWISS QUALITY.
SINCE 1938.



Let us solve your filtration task!

DEPTH FILTRATION FOR VALUABLE LIQUIDS.